REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 5, 10, and 20-29 are pending in the present application. Claims 5 and 20-27 are amended by the present response.

In the outstanding Office Action, Claims 5 and 20-27 were objected to; Claims 5, 10, 20-24, 28, and 29 were rejected under 35 U.S.C. § 103(a) as unpatentable over Kishi et al. (Japanese Application JP 2002-280642 A, herein "Kishi") in view of Hayashi et al. (U.S. Patent Application Publication No. 2002/0097540, herein "Hayashi"); Claims 26 and 27 were rejected under 35 U.S.C. § 103(a) as unpatentable over Kishi in view of Hayashi and Takada et al. (U.S. Patent No. 5,828,537, herein "Takada"); and Claims 5, 10, 20-22, 24, 25, 28, and 29 were rejected under 35 U.S.C. § 103(a) as unpatentable over Kishi in view of Koi et al. (U.S. Patent Application Publication No. 2001/0013999, herein "Koi").

Regarding the objection to Claims 5 and 20-27, Claims 5 and 20-27 have been amended as suggested by the outstanding Office Action without adding new matter. Accordingly, it is respectfully requested this objection be withdrawn.

Regarding the outstanding rejections of Claims 5, 10, and 20- 29 under various combinations of Kishi, Hayashi, Takada, and Koi, those rejections are respectfully traversed for the following reasons.

Briefly recapitulating, independent Claim 5 is directed to a magnetic memory that includes, *inter alia*, a magnetoresistance element. The magnetoresistance element has a free layer, a first pinned layer, and a first nonmagnetic layer between the free layer and the first pinned layer. The free layer includes a first ferromagnetic layer, a second ferromagnetic layer, and a nonmagnetic layer which intervenes between the first and second ferromagnetic layers. The nonmagnetic film is a layer selected from the group consisting of a first layer

made of molybdenum and having a thickness of 0.8 nm to 1.2 nm, a second layer made of rhenium and having a thickness of 1.4 nm to 1.8 nm, a third layer made of tungsten and having a thickness of 0.8 nm to 1.2 nm, and a fourth layer made of niobium and having a thickness of 1.4 nm to 1.8 nm. Independent Claim 10 recites similar features as independent Claim 5 with the exception that the nonmagnetic layer is made of one of silicon, germanium, Al_2O_3 and AlN.

In a non-limiting example, Figure 1 shows the free layer 11 including the first and second ferromagnetic layers 11a, the nonmagnetic film 11b, the first pinned layer 12, and the first nonmagnetic layer 13.

Turning to the applied art, Kishi shows in Figure 10 a magnetic memory having a free layer 9 and a pinned layer 13 separated from each other by a nonmagnetic layer 11. The free layer 9 has two magnetic layers 3 and 7 separated by a connection layer 5. As recognized by the outstanding Office Action at page 4, first full paragraph, "Kishi does not disclose that the nonmagnetic film is a layer made of" the claimed materials. For these reasons, the outstanding Office Action relies on Hayashi, which shows in Figure 64 a magnetic head having a structure different than Kishi but which includes some materials of the claimed materials and also rely on Koi for teaching some other materials of the claimed materials.

More specifically, the outstanding Office Action states at page 8, third full paragraph that "it is noted that the basic device structure and the basic principle of operation of Hayashi's device are very similar to that of Kishi's, namely, having a free layer and a fixed or pinned layer and the magnetoresistive interaction between the layers." The outstanding Office Action also states in the same paragraph that "Kishi discloses, in paragraphs [0001], [0042] and [0106], that its disclosure is applicable to a magnetic head." Based on these statements, the outstanding Office Action concludes in the same cited paragraph that "one of ordinary skill in the art would find Kishi and Hayashi to be analogous and combinable."

Applicants respectfully submit that the basic device structure of Hayashi is not similar to that of Kishi. In magneto-resistance effect heads, a magnetization of the free layer is oriented perpendicularly to that of the pinned layer when no magnetic field is applied. The vertical bias layers (layers 2b in Figure 64) in the device of Hayashi assist the free layer in achieving the magnetic orientation described above. That is, the vertical bias layers are essential to the device of Hayashi.

By contrast, in magnetic memories as in Kishi, a magnetization of the free layer is oriented parallel or antiparallel to that of the pinned layer when no magnetic field is applied. This magnetic orientation is achieved only by magnetizing the free and pinned layers in the same direction. That is, the vertical bias layers required in Hayashi are not necessary in the device of Kishi.

Thus, as described above, the magnetic orientation of the free layer in the device of Hayashi is different from that of the device in Kishi. In addition, the basic device structure of the device of Hayashi must include the vertical bias layers which are not necessary in the device of Kishi. Therefore, the basic device structure of Hayashi is not similar to that of Kishi. At least for these reasons, Applicants respectfully submit that one of ordinary skill in the art would not combine the teaching of Kishi and Hayashi.

Further, the basic principle of operation of the device of Hayashi device is not similar to that of the device of Kishi. As described above, in the magneto-resistance effect head, the magnetization of the free layer is oriented perpendicular to that of the pinned layer when no magnetic field is applied. When a magnetic field is applied to the head, the orientation of the magnetization of the free layer is changed within a small angle range. A magnitude of a sense current flowing through the magneto-resistance effect element is proportional to a cosine of an angle defined by an orientation of the magnetization of the free layer and that of

the pinned layer. In other words, the magneto-resistance effect element outputs the sense current as an analog signal.

By contrast, in the magnetic memory, the magnetization of the free layer is oriented parallel or antiparallel to that of the pinned layer when no magnetic field is applied. When the magnetic field is applied to the memory, the orientation of the magnetization of the free layer is reversed. A magnitude of the sense current flowing through the magneto-resistance effect element when the magnetization of the free layer is parallel to that of the pinned layer is different from a magnitude of the sense current flowing through the magneto-resistance effect element when the magnetization of the free layer is antiparallel to that of the pinned layer. In other words, the magneto-resistance effect element is a bistable device and outputs the sense current as a binary signal.

As described above, the magnetic orientation change of the free layer in the device of Hayashi is different from that in Kishi. In addition, an output of the device of Hayashi is different from that of the device of Kishi. Therefore, the basic principle of operation of the device of Hayashi is not similar to that of the device of Kishi.

Furthermore, Applicants respectfully submit that the disclosure of Kishi in paragraphs [0001], [0042] and [0106] does not support combining the teachings of Hayashi to Kishi. More specifically, the disclosure of Kishi in paragraphs [0001], [0042] and [0106] concerns only Kishi's magnetoresistance element and not all the magnetoresistance elements. That is, the disclosure does not suggest that all the magnetoresistance elements used in magnetic memories can be applied to magnetic heads nor that all the magnetoresistance elements used in magnetic heads can be applied to magnetic memories. The outstanding Office Action appears to broaden the disclosure of Kishi beyond the intention of that disclosure.

Based on the above presented arguments, Applicants respectfully submit that one of ordinary skill in the art would not find the teachings of Kishi and Hayashi to be analogous and combinable, as asserted by the outstanding Office Action.

Further, the paragraph bridging pages 8 and 9 of the outstanding Office Action states that "it is noted that Kishi was cited for the nonmagnetic film included in a free layer, while Hayashi was cites as a secondary reference from the analogous art to show equivalent materials for the nonmagnetic film of Kishi, that were known in the art and that would have been substituted for the nonmagnetic film of Kishi by one of ordinary skill in the art." The outstanding Office Action also mentions in the same paragraph that "[i]t is also noted that the nonmagnetic film in Hayashi is for coupling two adjacent magnetic layers, similar to that of Kishi (see Hayashi paragraph [0029]), with a thickness within the range disclosed in Kishi (see Hayashi paragraphs [0360]-[0366])." In short, the outstanding Office Action appears to indicate that one of ordinary skill in the art would consider the materials Nb, Mo, W, Re, Si, Ru, Au, Ag and Cu disclosed in Hayashi to be equivalent materials for the nonmagnetic film of the device of Kishi and that the nonmagnetic film in the device of Hayashi has the same role and thickness as the nonmagnetic film in the device of Kishi.

However, the device of Hayashi shown in Figure 64 has a nonmagnetic layer 4 and a free layer 3b formed on a fixed layer 5 in this order. The free layer 3b is covered with a multilayer including a nonmagnetic layer 9, a magnetic layer 8b, a nonmagnetic layer 13, and a magnetic layer 12. On the multilayer, a pair of vertical bias layers 2b are formed. The multilayer magnetically couples the free layer 3b with the vertical bias layers 2b.

Because the vertical bias layers are not necessary in magnetic memories as noted above, the multilayer of Hayashi is also not necessary in the magnetic memories. Therefore, Applicants respectfully submit that one of ordinary skill in the art would not consider the materials of the nonmagnetic layer 13 of Hayashi included in the multilayer as relevant for

the nonmagnetic layer included in the free layer of the magnetic memories because the nonmagnetic layers are used in different devices that function under different conditions.

The outstanding Office Action concludes on page 5, fourth full paragraph, that "[s]ince Hayashi discloses, for example in Fig. 10 and paragraph [0119], the equivalence of Al2O3 and AIN as a nonmagnetic material, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to select Al2O3 with a thickness of 1 nm (as in Takada) or equivalently AIN with a thickness of 0.5 nm to 1.5 nm (in view of Hayashi and Takada), and substitute it for the nonmagnetic film of Kishi."

However, the materials described in paragraph [0119] of Hayashi are not materials for a nonmagnetic layer included in a free layer, but materials for the nonmagnetic layer 4 interposed between the free layer 3b and the fixed layer 5. That is, Hayashi only suggests that Al_2O_3 and AIN are equivalent materials for the nonmagnetic layer 4 interposed between the free layer 3b and the fixed layer 5.

The nonmagnetic layer 4 does not magnetically couple the free layer 3b to the fixed layer 5, while a nonmagnetic layer included in the free layer magnetically couples together the ferromagnetic layers in the free layer. That is, the nonmagnetic layer 4 interposed between the free layer 3b and the fixed layer 5 is not equivalent to a nonmagnetic layer included in the free layer. In this regard, the outstanding Office Action does not provide any motivation to combine different nonmagnetic layers in Hayashi and Kishi.

Further, Takada discloses an $A1_2O_3$ layer having a thickness in the order of 10 nm or less as the nonmagnetic film 11c included in the magnetoresistance effect stabilizing layer 11 shown in Figure 5. However, the nonmagnetic layer is not included in the free layer.

When the magnetic field is applied to the device of Takada, the magnetization of the magnetoresistance effect stabilizing layer 11 does not reverse, while the magnetization of the free layer in the magnetic memory is reversed. This difference is produced not only by the

magnetic layers but also by the nonmagnetic layer therebetween. That is, the nonmagnetic film 11c included in the magnetoresistance effect stabilizing layer 11 is not equivalent to a nonmagnetic layer included in the free layer. In addition, the outstanding Office Action does not provide any motivation for combining the teachings of Takada and Kishi.

The outstanding Office Action states on page 7, second full paragraph that "Koi shows that Mo, W, Re, Si and Ge (recited in the instant claims) and Ru, Au, Ag and Cu (disclosed in Kishi) are equivalent materials known in the art, for their use as a nonmagnetic film material between magnetic layers." Based on this statement, the outstanding Office Action concludes in the same paragraph that "[s]ince these materials were art-recognized equivalents at the time the invention was made, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to select any material from the group consisting of Mo, W, Re, Si and Ge, and substitute it for the nonmagnetic film of Kishi."

However, the materials disclosed in paragraphs [0056] and [0057] of Koi are materials for the antiferromagnetic coupling layer 6 interposed between the pinned layers 5 and 7, and not materials for a nonmagnetic layer included in a free layer as requested by the pending claims.

When a magnetic field is applied to the device of Koi, the magnetizations of the pinned layers 5 and 7 do not reverse, while the magnetization of a free layer in the magnetic memory is reversed. This difference is produced not only by the magnetic layers but also by the nonmagnetic layer therebetween. That is, the antiferromagnetic coupling layer 6 interposed between the pinned layers 5 and 7 in Koi is not equivalent to a nonmagnetic layer included in a free layer. In addition, the outstanding Office Action does not provide any motivation for combining the teachings of Koi and Kishi.

Therefore, for the above noted reasons, Applicants respectfully submit that Claims 5 and 10 and each of the claims depending therefrom patentably distinguish over Kishi, Hayashi, Takada, and Koi, either alone or in combination.

Consequently, in light of the above-discussion and in view of the present amendments, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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